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PLANT COMPOSITION AND SOIL ACIDITY OF A MAINE BOG*

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Mt. Desert Island lies off the eastern coast of the state of Maine in latitude 44° north and longitude 68° west. The island is of peculiar interest on account of its unusual assemblage of plants and animals, and its remarkable influence on man.[2]

The predominant vegetation is northern, with a number of arctic alpine plants, a few of which elsewhere in this latitude occur only above timber line; and yet there is a mixture of southern forms. The same mixture of northern and southern forms is found in the insect fauna of the island. There are here presented brief observations on the plants of a small bog on the south side of the island near the village of Bass Harbor.

The bog in question is about fifty yards long by twenty-five wide and appears to be due to an undrained depression in a wide granite ledge. The granite, which comprises the hills of the island (extending over 1,500 feet elevation) and much of the more level parts, is pink in some places and gray in others, and rather coarsely crystalline. It cooled at a considerable distance below the surface and was later exposed by erosion.[3] The granite in this case was pink, made up of quartz, potassium feldspar, a little mica, and hornblende.

The bog proper contains no open water and is covered chiefly with sedges. Around the margin of the bog is a stunted rather open growth of black spruce with a mixture of larch, *Larix laricina,* and a little Arborvitae, *Thuja occidentalis,* none of the trees exceeding ten feet in height. A few feet beyond this margin there are in places outcrops of the granite ledge on which grow plants of peculiar interest. Three sites, quite different edaphically, are represented in an area not exceeding an acre in size. Two of these sites, the bog proper and the rock ledge, are xerophytic, the former from lack of moisture, the latter from the character of its water. The marginal site, or forest, which merges with the surrounding forest, is mesophytic.

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* Contributions from the Brooklyn Botanic Garden 26.

[1] Presented before the Ecological Society at its meeting in Chicago, December, 1920.

[2] The plants have been partially listed by Rand and Redfield in their "Flora of Mt. Desert Island, Maine," John Wilson and Son, Cambridge, Mass., 1894. The forest types have been briefly described by Moore in "Some Factors Influencing the Reproduction of Red Spruce, Balsam Fir and White Pine" Jour. For. Vol. 15, No. 7, pp. 827–853, 1917.

[3] Shaler, N. S. "Geology of Mt. Desert Island" U. S. Geol. Survey, 8th Ann. Rept. of the Director, 1889.

The acidity of the soil in each of the three sites was tested by Dr. Wherry's field method.[4] In the bog proper the water under a growth of sedges which probably represents the earlier stages of succession, and also the water from under a tussock of sphagnum amongst roots of *Chamaedaphne* and cranberry, which appears to be a later stage than the sedge, had a specific acidity of 300 +, or P_H 4.5. The water squeezed by hand from the peat under the sedge had a specific acidity of 300; that squeezed from the sphagnum under the *Chamaedaphne* was 1,000, or P_H 4.0. The latter value is the highest acidity found on Mt. Desert Island out of a considerable number of tests made up to this time (July, 1920).

On the rock ledge there was no soil except the humus from the plants themselves, mixed with a small amount of mineral particles. The humus in which were growing the roots of the crowberry, *Empetrum nigrum,* had a specific acidity of 100, P_H 5.0. It will be noticed that this acidity is much lower than that in the bog proper.

Tests in the forest at the margin of the bog revealed a surprisingly low degree of acidity in both the humus and underlying mineral soil. The humus, mostly dark decomposed sphagnum, under a black spruce tree, was 5 inches deep and had a specific acidity of only 10, P_H 6.0. Beneath this humus the mineral soil, apparently decomposed granite, is of an ashy gray color so characteristic of the soil just beneath the humus in the coniferous forests of the northeast. This mineral soil, without admixture of humus, showed a specific acidity of 10. In amongst the roots of a small Arborvitae, *Thuja occidentalis,* at the edge of the bog, the humus had a specific acidity of 300, P_H 4.5, which is the highest on which this tree has been found growing by the writers.

The three sites, it will be seen, ranged from comparatively low to high acidity, and the stage of vegetative succession corresponded with the degree of acidity, the earlier stage showing the strongest reaction. But this should not be taken as indicating a general principle, because the red spruce forest, which is later than any of the stages on the area in question, shows an acidity in the surface humus of 300 +.

Almost two months later, at the end of August, the bog had, owing to an unusually dry season, lost a large proportion of its water, and tests showed that there had been a considerable decrease in acidity. The water squeezed from brown sphagnum had an acidity of 500, P_H 4.0 to 4.5. The underlying black muck, representing a more complete stage of decomposition, had a specific acidity of 100. Beneath this was a mucky grayish clay, which seems to correspond with the gray soil in the marginal forest, but appears to be considerably finer and to have more colloidal material. It appears that the drying up in the summer, instead of making the acids stronger through higher concentration, has somewhat diminished their intensity, probably through oxidation.

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[4] Wherry, E. T. "Soil Acidity and a Field Method for its Measurement." Ecology, Vol. 1, No. 3, pp. 160–173, 1920.

Some plants are confined to one site, while a few grow on all three. One striking effect of the diverse habitats will be obvious after consideration of the plants growing on the bog proper, on its predominately woody fringe, and on the rocky ledge at its north end.

The open bog is dominated by *Carex atlantica, Carex oligosperma, Rynchospora fusca,* and *Eriophorum angustifolium.* The first three make up a dense mat in all the lower parts of the bog, while the *Eriophorum* is scattered freely through the other sedges. On mounds of Sphagnum and often over nearly exclusive tussocks of *Polytrichum strictum* there is a group of secondary species, which, arranged in the order of frequency, is as follows:

Chamaedaphne calyculata
Rhododendron canadense
Kalmia angustifolia
Vaccinium Oxycoccus
Ledum groenlandicum
Sporobulus uniflorus
Carex canescens
Carex cephalantha
Calopogon pulchellus
Solidago uniligulata
Eriophorum virginicum
Carex paupercula
Carex oligosperma
Drosera intermedia
Larix laricina (seedlings only)

The general distribution of these plants shows that in the bog proper 25 percent are Arctic-Alpine, 25 percent Hudsonian, 18.7 percent Canadian, while 31.3 percent are plants of such general distribution as to be of little significance.

The forest at the edge of the bog proper is slightly higher than the open sedge vegetation of the middle of the bog. This fringe, with here and there obvious intruders from the open bog, is made up of the following species, also arranged in order of frequency:

Chamaedaphne calyculata
Larix laricina (small trees)
Ledum groenlandicum
Rhododendron canadense
Picea mariana (about 10 feet tall)
Spiraea latifolia
Thuja occidentalis
Gaylussacia baccata (in the water!)
Viburnum cassinoides
Betula populifolia
Nemopanthus mucronata

Unlike the bog proper, this assemblage of plants shows no Arctic-Alpine affinities, 36.4 percent being of Hudsonian, 36.4 percent Canadian, and 27.2 percent of widely distributed species.

Upon the rocky ledge there are certain species not found in either of the other localities. Those found on the actually dry rocky ledge are floristically related to those of the physiologically dry bog. Larch, however, which is a tree of moist situations, is more abundant on the rocky ledge than on the bog proper. The plants of the flat rock ledge are as follows, again arranged in order of frequency:

Empetrum nigrum (covering much of the ledge)
Larix laricina
Chamaedaphne calyculata
Kalmia angustifolia
Myrica carolinensis
Picea mariana
Pyrus melanocarpa
Gaylussacia baccata
Myrica asplenifolia
Thuja occidentalis
Cornus canadensis
Pinus resinosa
Betula populifolia
Vaccinium pennsylvanicum
Vaccinium pennsylvanicum angustifolium
Amelanchier oblongifolia
Alnus crispa mollis

As to their geographical affinities, these species may be assigned to Arctic-Alpine 6.3 percent, Hudsonian 31.2 percent, Canadian 37.5 percent, and the remaining widely distributed species 25 percent.

The affinities of the three sites are summarized in the following table:

	Arctic Alpine	Hudsonian	Canadian	Widely distributed
Bog proper	25%	25%	18.7%	31.3%
Woody fringe of the bog		36.4%	36.4%	27.2%
Rocky ledge	6.3%	31.2%	37.5%	25%

It is interesting that the arctic alpine plants are here found only on the two sites representing the earlier stages of succession, and that as the succession advances there is a diminution in the alpine plants.

Summary

Brief observation of a small bog near Bass Harbor on Mount Desert Island, Maine, showed the specific acidity in the bog proper to run from 300— to 1,000, P_H 4.5 to 4.0, the acidity of the humus under roots of crowberry, *Empetrum nigrum*, on a granite ledge within a few feet of the bog to be 100, and that of the black spruce forest around the bog to be 10, P_H 6.0. The floristic composition of these three sites is quite different. The bog proper contains 25 percent of arctic alpine species, the rock ledge 6.3 percent, and the marginal forest none. Thus the arctic alpine plants are here found only on the earlier stages of succession.